

Fluency or Congruence? The Role of Metacognitive Monitoring on Attribute Ratings

by

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### Abstract

Processing fluency is a metacognitive cue which can influence both cognitive processes and various judgments, and which can be heightened through directed forgetting (Alter & Oppenheimer, 2009; Lanska, Olds, & Westerman, 2014). Similarly, the incongruence of novel information with an activated schema can cause a cognitive processing slowdown (Dickinson, 2011; Duffy & Keir, 2004). Information is easier to process (therefore, has higher fluency) when it is consistent with previously encountered schemas. In this study, processing fluency was manipulated by presenting participants with information which was consistent or inconsistent with a prior schema. Eye-movements were then measured to evaluate participants' reading speeds in passages which were schema congruent or incongruent. Results demonstrated an interaction between priming condition and schema congruence as well as an interaction between schema congruence and character gender for first-pass dwell times. Results also showed total dwell time differences between conditions of congruence and character genders, respectively. Furthermore, likeability ratings demonstrated that when counter-stereotypical gender information had been primed, schema incongruent female characters were rated as being less likeable than their male counterparts. These results are discussed in terms of their social implications.

*Keywords.* Schemas, Fluency, Directed Forgetting, Eye-tracking, Familiarity, Likeability.

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## Table of Contents

Thesis Defence Committee .....	ii
Abstract .....	iii
Acknowledgments .....	iiv
Table of Contents .....	v
List of Tables .....	vii
List of Appendices .....	vi
Fluency or congruence? The role of metacognitive monitoring on attribute ratings. ....	1
Processing fluency .....	2
Directed forgetting.....	6
Schemas.....	11
Justification of the current study .....	14
Method .....	15
Materials.....	16
Procedures .....	18
Results.....	20
Eye-movements.....	20
Attribute ratings .....	22
Explicit awareness.....	24
Discussion .....	25
Eye-movements.....	25
Attribute ratings .....	32
Explicit awareness.....	36

Limitations and future directions .....	37
Conclusion .....	38
References .....	40
Appendices.....	48

## List of Tables

Table 1: Mean familiarity ratings by character gender, congruence condition, and priming condition. ....	49
Table 2: Mean likeability ratings by character gender, congruence condition, and priming condition .....	50
Table 3: Mean first-pass dwell time by character gender, congruence condition, and priming condition .....	51
Table 4: Mean total fixation time in the target area (reflexive pronouns) by character gender, congruence condition, and priming condition .....	52
Table 5: Frequency of theme awareness responses by category.....	53

## List of Appendices

Appendix A: Sample of stimuli in each condition of congruence and character gender.....	48
Appendix B: Tables .....	49



### Fluency or Congruence? The Role of Metacognitive Monitoring on Attribute Ratings

Processing fluency is the ease or difficulty that is experienced when processing a piece of information (Alter & Oppenheimer, 2009; Oppenheimer, 2008; Oppenheimer & Frank, 2008). This ease or difficulty can have an impact on cognitive processing, as well as on judgments about the material. For example, Alter and Oppenheimer (2009) have written a review of perceptual, conceptual, and linguistic fluency as well as their effects on tests of recall, recognition, timed reading tasks, judgment tasks and measures of preference. Generally, the finding has been that higher fluency leads to easier processing, which in turn may lead to more positive judgments and affective ratings (Lanska, Olds, & Westerman, 2015; Lee & Labroo, 2004; Reber, Winkielman, & Schwarz, 1998). One method of heightening fluency is directed forgetting, a manipulation according to which participants are instructed to forget previously presented information, which is hypothesized to increase the repetition and therefore the accessibility of such information in the working memory (Araya, Ekehammar, & Akrami, 2003; Bjork & Bjork, 2003). This hypothesis has been supported using direct and indirect tests of memory including those of recall, recognition, perceptual identification, and word completion (MacLeod, 1989). Throughout this variety of tests of memory, it has been shown that performance is heightened when individuals are directed to forget primes as opposed to when they are instructed to remember them (Araya et al., 2003; Bjork & Bjork, 2003; MacLeod, 1989). However, it has been suggested that these results are not due to an explicit awareness of the theme or of the effects of the previously presented information on the cognitive processing (Bjork & Bjork, 2003; Lenton, Blair, & Hastie, 2001). This opposes the conception of processing fluency as given by Oppenheimer (2008), who states that an individual must be aware of the manipulation of the ease or difficulty of processing for it to impact cognitive processing, so it

will therefore be of interest in the current study. Furthermore, research on processing fluency and directed forgetting has been conducted using conceptual and stereotypical information (Alter & Oppenheimer, 2009; Araya et al., 2003; Lenton et al., 2001).

Consequently, the current study will employ both conceptual processing fluency and directed forgetting in conjunction with stereotypical information related to mental representations of gender. These mental representations are otherwise called schemas and are built based on previous experiences (Bransford & Johnson, 1972; Carreiras, Garnham, Oakhill, & Cain, 1996). Most notably, similarly to processing fluency, schemas may aid or hinder cognitive processing. For example, Duffy and Keir (2004) found that when a gender schema is violated by information which is non-congruent with it processing tends to slow, and participants tend to return to previous parts of a passage to verify their understanding. This finding was reiterated by Dickinson (2011), who reported that processing slowed when information which was non-congruent with schemas of sexuality was encountered. Since processing fluency and schema congruence have similar effects on cognitive processing, the current study will attempt to combine these. Directed forgetting will be employed as a fluency manipulation, but this will be done in a reading task instead of a memory task using categorization or direct recall because the former has a higher ecological validity (Aaronson, 1984; MacCrae et al., 2002). Finally, reading latencies, awareness of the prime, likeability, and familiarity will be evaluated to measure the manipulations' effects on cognitive processing and various judgments.

### **Processing Fluency**

Processing fluency is a metacognitive cue which can be defined as the ease with which we can access or process information (Alter & Oppenheimer, 2009; Laham, Alter, & Goodwin, 2009; Lanska et al., 2015; Lanska, Olds, & Westerman, 2015; Oppenheimer & Frank, 2008;

Whittlesea, 1993). This is the case because cognitive processing of various pieces of information is due to both a featural and a conceptual understanding of said information, meaning that the perceptual features of the stimulus (font, style, size, colour) and an understanding of the underlying cognitive content relevant to the stimulus can influence a person's ability to process it. For example, Oppenheimer and Frank (2008) showed that in addition to the cognitive understanding of the concept underlying an exemplar, the perceptual features of the stimulus could influence its rated category membership. In an earlier study by Schwarz et al. (1991), it had even been suggested that the effect of fluency on cognitive processing may be greater than that of previous cognitive content. In this study, participants in the high fluency condition who had been asked to recall fewer examples of assertiveness found it easier to complete the subsequent judgement task than those in the lower fluency condition where they were asked to recall more examples of assertiveness (Schwarz et al., 1991). Together, these findings demonstrate that processing fluency seemingly plays an equal or greater role in cognitive processing than does cognitive content.

In following, processing fluency may take various forms, including perceptual fluency, memory-based fluency, or higher order cognitive fluency such as conceptual fluency or spatial reasoning (Alter & Oppenheimer, 2009). The first facet, perceptual fluency, can be defined as the experience of ease of processing due to the featural presentation of a stimulus (Alter & Oppenheimer, 2009). As previously stated, the study conducted by Oppenheimer and Frank (2008) included manipulations of the font, style, and size of stimuli, and resulted in varied category-membership and ratings of likeability and familiarity of these stimuli. In another example, Reber et al. (1998) manipulated the contrast between stimuli and their backgrounds to alter the ease of the visual perception of shapes. These studies attest to the notion that processing

fluency can, in a first instance, be manipulated by changing the perceptual properties of a stimulus. Furthermore, the ease with which one can retrieve information about the target stimulus can be altered to produce highly fluent or disfluent stimuli (Alter & Oppenheimer, 2009; Winkielman, Schwarz, & Belli, 1998). For example, Tversky and Kahneman (1973) conducted an experiment in which participants had to recall exemplars beginning with the letter K or whose third letter was a K and found that participants more easily recalled exemplars in the first, more fluent condition. A further example comes from Castel, McCabe, and Roediger (2007), who asked participants to encode identical pairs of words or pairs of words that were different from each other and found that those in the first condition were more easily remembered. Hence, these studies, among others, demonstrate that processing fluency can be affected by both the ease of retrieval or the ease of encoding of the information, both of which are considered forms of memory-based fluency. Finally, processing fluency can take the form of easy or difficult higher-order cognitive processing (Alter & Oppenheimer, 2009). Relevant to the current study is the facet of conceptual fluency according to which semantically-related pieces of information are more fluent than semantically unrelated concepts and are therefore processed more easily. Whittlesea (1993) found that participants could pronounce words which were embedded in a predictive context (e.g. “stormy seas tossed the boat”) more quickly than those which were found in non-predictive contexts (e.g. “stormy seas tossed the lamp”). This affirmed that semantically-related concepts can be primed by presenting participants with specific target words; for example, the word ‘doctor’ was found to prime the word ‘nurse’. In following, Lee and Labroo (2004) found that participants completed an evaluative task about various products from different brands more easily when they had been primed with conceptually-related advertisements than when they had previously seen conceptually unrelated advertisements.

Furthermore, a study by Day and Gentner (in Alter & Oppenheimer, 2009) found that participants with little knowledge of a subject found it easier to process complex excerpts of texts after having previously read a conceptually-related passage. This evidence supports the idea that information is easier to process when semantically related information is presented before or alongside it. In the current study, conceptual fluency will be manipulated by presenting participants with passages of a text that is either semantically-related or unrelated to the concept of gender so as to render subsequent processing easier or more difficult.

Furthermore, it is hypothesized that the manipulation of the ease of processing of information has an effect on a person's affective experience, which may in turn influence their judgements of the information (Lanska et al., 2015; Reber, Schwarz, & Winkielman, 2004; Sanchez & Jaeger, 2015; Winkielman & Cacioppo, 2001; Winkielman, Schwarz, Reber, and Fazendeiro, 2007). A first explanation of this comes from the hedonic marking hypothesis which states that the positive affective experience which stems from easier processing leads to more positive affective ratings of the stimulus; for example, stimuli are judged as being more likeable when they are presented more fluently (Laham et al., 2009; Winkielman, Schwarz, Fazendeiro, and Reber, 2003; Winkielman et al., 2007). A second explanation suggests that higher fluency increases the perceived familiarity of a stimulus, which in turn heightens judgements of likeability (Lanska et al., 2015; Winkielman et al., 2003; Winkielman et al., 2007). However, many findings related to processing fluency have shown that increased fluency leads to increased judgements of likeability, and that decreased fluency has an opposite effect, thus lending support to the hedonic marking hypothesis. For example, Reber et al. (1998) found that participants preferred stimuli whose fluency was heightened through presenting them against highly-contrasting backgrounds over those presented against less contrasting backgrounds. In following,

Winkielman and Cacioppo (2001) presented participants with various line drawings that had been primed with either matching (fluent) or non-matching (disfluent) contours and found that participants' facial expressions were more positive in response to fluent stimuli and that they preferred these to their disfluent counterparts. More recently, Lanska et al. (2015) used black-and-white line drawings which had been primed using the same image, a different image, or no image and found that increased fluency lead to more positive ratings of familiarity and of likeability. In short, these studies demonstrate the effects of perceptual fluency on stimulus preference and ratings of likeability. Similar findings about the effects of fluency on judgements of likeability have been found in different modalities of processing fluency manipulations, including that of conceptual fluency. In the previously explained study by Lee and Labroo (2004), both perceptual and conceptual fluency were manipulated to evaluate their effects on brand likeability. Participants were shown advertisement images which were related or unrelated to a specific product, and, in turn, were asked to rate the likeability of these products. Results of this study showed that along with finding conceptually-primed products easier to evaluate, participants also seemed to evaluate these products more favorably than non-conceptually-primed products (Lee & Labroo, 2004). As such, both conceptual and perceptual fluency had effects on participants' judgements, and increased fluency lead to increased likeability. Lanska et al. (2015) consolidated the finding that perceptual and conceptual fluency similarly increase ease of processing by demonstrating that both produced similar results on a test of recognition. That is, when participants were asked to recognize which black-and-white line drawings they had previously seen, those who had been primed with the same image (high conceptual fluency, high perceptual fluency) had more positive responses than those who had been primed with different images (high conceptual fluency, low perceptual fluency) or no images at all (low conceptual

fluency, low perceptual fluency). Thus, increased fluency in both the perceptual and conceptual modalities lead to more positive responses to test items in between-subject and within-subject designs (Lanska et al., 2015). However, although this study reaffirmed the similarity of the effects of these modalities on ease of processing independently it did not explore their effects on ratings of likeability. Thus, the effect of conceptual fluency alone on ratings of likeability has not greatly been explored. Accordingly, the current study will evaluate the influence of conceptual fluency on both ease of processing as well as on judgements of likeability.

### **Directed Forgetting**

A common technique used to heighten processing fluency is repeated exposure to a specific stimulus (Bornstein & D'Agostino, 1994; MacLeod, 1989; Landwehr, Golla, & Reber, 2017; Reber et al., 1998; Reber et al., 2004; Winkielman et al., 2007). Coupled with the preference for a stimulus established by previous exposure to it, repeated exposure to this same stimulus increases the affective experience of the participant thus leading to more positive evaluative judgements of the stimulus (Landwehr, Golla, & Reber, 2017). However, repeated exposure to the stimulus need not be perceptual; that is, an individual need not be repeatedly exposed to visual or auditory stimuli to enhance their fluency. Contrarily, fluency may be heightened through repeated exposure to a prime in the working memory. For instance, it has been found that attempts to intentionally forget information may increase its accessibility (and its fluency accordingly) because the to-be-forgotten (TBF) information becomes repeatedly primed in the memory (Araya et al., 2003; MacCrae, Bodenhausen, Milne, & Ford, 1997). In fact, it has been suggested that TBF information remains in the memory as strongly as to-be-remembered (TBR) information and can thus be recognized, recalled, or relearned as easily as the latter (Bjork & Bjork, 2003). Briefly, this means that directed forgetting, an encoding manipulation in

which participants are instructed to forget a piece of information, can lead to this concept being repeated in the memory as strongly as TBR information thus increasing its fluency. In turn, this heightened fluency should increase the likeability of the item.

Directed forgetting has often been used in memory tasks including free recall, recognition, and word completion tasks, as well as in tandem with the Deese-Roediger-McDermott (DRM) paradigm. Within this paradigm, participants read a list of words which share a common theme that is not explicitly presented. For example, the words ‘ant’, ‘bee’, and ‘dragonfly’ would relate to the theme of ‘insects’. Following this, they are presented with a test of recall or recognition which consists of the presentation of a new list of words containing the thematic word (McBride, Coane, & Raulerson, 2006). The overall findings in these tasks have been that directed forgetting has a similar effect on both direct and indirect memory processes, and that it tends to increase false recognition in the DRM paradigm (Bjork & Bjork, 2003; MacLeod, 1989). For example, in a study conducted by Araya et al. (2003), participants were subjected to a neutral or to a stereotypical prime, and then told either to remember or to forget this information. They then proceeded to complete a DRM task related to the preceding stereotype. The results of this study showed that participants in the stereotyped prime condition tended to falsely recognize stereotypically-congruent items on a novel list of words only under the forget instruction (Araya et al., 2003). In summary, these results suggest that directed forgetting had a stronger influence on the recognition of stereotypical information than did directed remembering in the stereotyped-prime condition. This reaffirms that directed forgetting likely has an equal or greater influence on processing than directed remembering, but also suggests that it may have an impact on conceptual fluency since the recognition of conceptually-related information was elevated. Such a finding is relevant to the current study since the



employment of this encoding manipulation will be used to increase the conceptual fluency of stereotypical information about gender.

In contrast, it has been repeatedly hypothesized that the increase in false recognition in memory tasks such as the DRM is either due to a list-discrimination source-type error or to an overall lack of awareness that certain items had been presented earlier. In the first case, participants may be unable to discriminate between thematic information presented on the first list and the second list in a DRM task, thus they ‘recognize’ more items that had not previously been presented. Alternatively, it is also possible that participants are completely unaware that certain items have previously been presented at all, thus when they encounter them on the second list they identify them as being congruent with the theme and falsely recognize them. In spite of this, Bjork and Bjork (2003) were able to demonstrate that directed forgetting does not evoke one source-type error or the other but produces a combination of both by employing a fame-judgement task in which participants read a list of names followed by another, and were asked to identify which names on the second list belonged to famous individuals. These authors hypothesized that directed forgetting gave rise to feelings of familiarity whose source could not be recognized by the participants, thus they falsely recognized more items than those in the directed remembering condition (Bjork & Bjork, 2003). That directed forgetting may have increased feelings of familiarity attests to its impact on processing fluency since it suggests that the information becomes more accessible when we are told to forget it.

More notably, the lack of awareness of the source of these feelings of familiarity or of the information impacting their judgements is relevant to the current study. In a study conducted by Lenton et al. (2001), the lack of awareness of a prime was further developed since participants reported little awareness of the underlying theme of gender in a DRM paradigm which included

gender-stereotyped occupations. In this study, participants were subjected to the DRM paradigm, and were then asked to rate their confidence in the recognition of each word in the second list. They were then queried as to whether they had noticed any themes among the words they had received in the exposure phase, and only 22% of participants were aware of the overarching gender theme. Though this study did not use directed forgetting, it suggests that although previously encountered information has an impact on subsequent processing participants are not always aware of this link. To paraphrase, though the preceding presentation of stereotypical information may increase the subjective feeling of ease of processing of the information (thus impacting recognition), participants may not be aware of the concepts which relate this information to the stimuli they are currently encountering (Lenton et al., 2001; Reber et al., 1998). Furthermore, Lewicki, Czyzewska, and Hoffman (1987) had previously shown that awareness of an ease of processing manipulation is not required for the manipulation to impact processing. In their study, participants had to identify a target stimulus in a frame after having previously been exposed to frames in which target stimuli were presented in specific patterns. Interviews conducted after the experiment revealed that subjects remained unaware of the patterns they had witnessed, but latency responses suggested that their cognitive processing had been affected by the priming trials. In fact, their results demonstrated that once the primed pattern was replaced with a novel pattern, response latencies increased (Lewicki et al., 1987). Therefore, though participants remained unaware of the manipulation of the level of difficulty of processing between trials, the process of stimulus recognition was altered when a new manipulation was introduced, suggesting that the previously presented patterns had been encoded and were influencing participants' recognition of new patterns. These findings contradict the suggestion by Oppenheimer (2008) who has said that a metacognitive cue such as fluency can

impact cognitive processing only if the individual is aware of the ease or difficulty they are experiencing. According to the latter, fluency is the awareness of the degree of difficulty stemming from the increased or decreased ease of processing which impacts cognitive processing, and which can impact judgements in various domains (Oppenheimer, 2008). Since the findings surrounding an individual's awareness of the manipulations of ease of processing are conflictual, it is of interest to the current study to distinguish whether the awareness of a manipulation is necessary for the experience of fluency to affect cognitive processing. In sum, directed forgetting will be employed alongside stereotypical gender information in the current study, and participants' awareness of the stereotyped-theme will be evaluated after they have completed their cognitive processing. Moreover, though there is much empirical evidence for the role of directed forgetting as a means of heightening fluency in memory tasks, we will seek to evaluate its effects on familiarity, likeability, and awareness in a reading task. It is hypothesized that feelings of familiarity will be heightened as a function of the priming condition within the current study, wherein participants who receive the neutral prime will rate schema congruent characters as being more familiar than incongruent characters, and those who receive the gendered prime will have opposite results. It is anticipated that participants who receive the gendered prime will rate schema congruent males as being the most likeable, followed by schema congruent females, schema incongruent females, and schema incongruent males. The ratings of likeability for those who receive the neutral prime are expected to differ only as a function of schema congruence, where congruent information will be rated as being more likeable than incongruent information. Finally, it is expected that participants will be aware of the overarching theme of gender within this study, but that this will not have an effect on their attribute ratings.

**Schemas**

The stereotypes used in some studies pertaining to directed forgetting are part of larger semantic models called schemas, which are mental representations of people, groups, places, objects, or events (Bransford & Johnson, 1972; Carreiras et al., 1996; Dickinson, 2011; Garnham, 1981). These mental representations aid us in organizing and interpreting information quickly, so they impact cognitive processes such as recognition, reading, and text comprehension (Banaji & Hardin, 1996; Bransford & Johnson, 1972; Carreiras et al., 1996; Duffy & Keir, 2004; Kennison & Trofe, 2003). Since schemas are constructed through previous experiences and are automatically activated when schematic information is encountered, it follows that exposure to a sole concept or stimulus activates the entirety of the mental model (Duffy & Keir, 2004; Garnham, 1981). For example, when one encounters the word ‘electrician’, which is a stereotypically male occupation, a gender schema is activated. Thus, cognitive processing related to the gender schema is activated as soon as stereotypical words or content is encountered. Moreover, though directed forgetting has most often been used in tests of recognition, the conceptual content of these tests is similar to that which will be used in the current study; to elaborate, the effects of directed forgetting have been made evident in studies pertaining to stereotypes. For example, MacCrae et al. (2002) used gendered stereotypes about occupations to demonstrate the effects of category-based thinking on recognition and awareness. Furthermore, Araya et al. (2003) used cultural stereotypes to show that directed forgetting had a significant impact on the cognitive processing and metacognitive awareness of a primed concept. Thus, directed forgetting has been used in conjunction with schematic information to evaluate both cognitive and metacognitive processing. In addition, it has been suggested that processing fluency, namely conceptual fluency, and directed forgetting function similarly: both may heighten the familiarity of a stimulus or concept through repeated priming, rendering this

concept as well as those semantically-related to it more accessible and more easily processed (Alter & Oppenheimer, 2008; Araya et al., 2003; Bjork & Bjork, 2003; Labroo, Dahr, & Schwarz, 2007; Lenton et al., 2001; MacCrae, Schloerscheidt, Bodenhausen, & Milne, 2002; Westerman, Lloyd, & Miller, 2002). Since both fluency and directed forgetting are able to activate semantically-related information to that which is encountered, they are seemingly related to schemas which can also be activated when only one piece of the model is encountered (Duffy & Keir, 2004). Therefore, it would follow that directed forgetting and conceptual fluency can be used to impact the cognitive processing of schemas, as will be done in the current study.

As has been mentioned, entire schematic models are automatically activated when schematic information is encountered, and this is done on-line; that is, schemas are continuously updated whilst new information is being processed (Garnham, 1981). Due to the automatic activation and continuous updating of the mental model, individuals tend to formulate certain expectations which, when violated, cause their cognitive processes to momentarily slow. For example, Banaji and Hardin (1996) found that pronouns which matched the gender-prime that had been previously shown were processed more quickly than pronouns which were opposite to the gender-prime. These authors suggest that these findings were likely due to the automatic beliefs that were activated by the prime and confirmed the automatic nature of stereotype activation in a second experiment (Banaji & Hardin, 1996). This study provides evidence that stereotypes, or schematic models, are activated instantly when stereotypical information is encountered, and that information which is congruent with the activated schema is processed more quickly than non-congruent information. Duffy and Keir (2004) reaffirmed the processing slowdown which occurs when schema-non-congruent information is encountered by a reader. In this study, participants read passages with or without prior contextual knowledge about the

gender of the subject. In conditions where no prior context was given and where the presented information contradicted stereotypes (e.g. schema-non-congruent information was presented), the authors noted higher reading-times as well as a tendency to reread earlier parts of the sentence so as to make sense of the information they were encountering (Duffy & Keir, 2004). Therefore, the results of this condition reiterate the effect of non-congruent schematic information on cognitive processing. In a more recent study, Dickinson (2011) evaluated cognitive processing related to schemas of sexuality. In this study, participants were shown video primes depicting heterosexual or homosexual families, and then read passages that were congruent or non-congruent with schemas of sexuality. The results of this study confirmed that when a character is assumed to be heterosexual and is later identified as being homosexual – that is, when encountered information contradicted the automatically activated schema of sexuality – reading speeds tended to slow (Dickinson, 2011). Furthermore, when participants were subjected to the homosexual prime condition and then encountered a female heterosexual character reading times also slowed. However, this was not the case for male characters, which suggests a difference in the entrenchment of schemas of sexuality between genders (Dickinson, 2011). Overall, the results of this study maintain the idea that when information which is non-congruent with the schema which is previously activated, processing times slow. This difference in processing speeds between schema-congruent and schema-non-congruent information has been attributed to the mismatch effect. According to this notion, it is the mismatch between the activated stereotype and the encountered information which leads to the processing slowdown (Johnston & Hawley, 1994). This slowdown due to a mismatch between a schema and encountered information will be incorporated in the current study by presenting participants with a gendered or a neutral prime, and then by having them read a short passage. It is hypothesized

that those who receive the gendered prime will have faster overall reading speeds for schema congruent passages and slower reading speeds for schema incongruent passages than those who had previously received the neutral prime (Bjork & Bjork, 2003; Dickinson, 2011; Duffy & Keir, 2004). Additionally, it is hypothesized that those who receive the gendered prime will read schema incongruent information more slowly than schema congruent information in their first pass through the passages. Furthermore, it is hypothesized that schema congruent information related to male characters will be processed more quickly than schema congruent information related to female characters in the first pass through the text and overall. However, it is anticipated that schema incongruent information related to males will be processed more slowly than schema incongruent information related to females in both measures of reading speed.

### **Justification of the Current Study**

Processing fluency is a metacognitive cue which can influence cognitive processes as well as various judgments. Similarly, the incongruence of novel information with a previously activated schema can also impact cognitive processing and attribute ratings. In brief, since both, respectively, produce similar effects in cognitive tasks, this study will serve to unveil whether a violation of schematic information or the lack of a semantically-related prime has a greater influence on cognitive processing. Thus, processing fluency and schema congruence will serve as independent variables in the current study. Since previous research regarding processing fluency has used semantically-related information, gender stereotypical and counter-stereotypical information will be used as the manipulation of schema congruence. Furthermore, directed forgetting will be employed to enhance the implicit priming of a conceptually fluent or disfluent text, thus heightening processing fluency. By using eye-tracking measures, reading speed will be measured as a dependent variable. Furthermore, attribute ratings will be measured as a dependent

variable to provide support for or against the hedonic marking hypothesis, according to which more easily processed stimuli will be rated more positively than difficult to process stimuli. Finally, this study will explore the need for explicit awareness in research pertaining to processing fluency and schemas, so the awareness of processing fluency and theme will be measured and included as an independent variable. Importantly, should information which is congruent with a previously encountered, semantically-related prime be more easily processed, it would suggest that one must only encounter semantically-related information to activate and add to a stereotype. To elaborate, should directed forgetting heighten the effects of congruence on reading speeds by repeatedly priming the previously encountered theme in the memory, it would suggest that the former is increasing the ease with which congruent information is being added to an existing schema. Furthermore, if participants are not aware of the heightened ease they are experiencing due to the fact of having previously encountered similar information, this would mean that congruent information can be added to a schema even when it is not recognized that this schema has already been activated in one's memory. This finding could have social implications, as it could indicate that stereotypes are constantly being activated and added to when there is no recognized link between themselves and a previously encountered piece of information. It would also mean that counter-stereotypical information may be processed more slowly should the stereotype itself have been primed.

## **Method**

### **Participants**

A total of 80 (61 females, 18 males, 1 gender-fluid) participants were recruited from English undergraduate classes at Laurentian University for the current study. Participants ranged in age from 17 to 38, with a mean age of 19.9 (SD=3.02). All participants had normal to



corrected-normal vision and identified English as being their first language. Participants were divided between two priming conditions, one of which received a gendered prime (N=40) and one of which received a neutral prime (N=40). All participants encountered the same schema congruent and schema incongruent passages.

## **Materials**

**Eye movements.** The EyeLink 1000 eye-tracking system developed by SR Research Ltd. as well as its accompanying software were used to measure ocular movements during the experiment. This system has a 2000 Hz Monocular sampling rate and a 0.50° accuracy and is comprised of a camera and an infrared sensor which were placed between the participant and a desktop computer screen. This display screen is connected to a host computer which gives feedback about participants' gazes throughout the experiment via an Ethernet cable. Participants' heads were placed on a chin rest to ensure stability during the experiment. First-pass dwell time and total fixation duration were recorded as indicators of participants' reading speeds, since these have been used previously in research related to fluency as well as schematic information (Kreiner, Sturt, & Garrod, 2007; Sanchez & Jaeger, 2015).

Two eye-tracking measures served as dependant variables: first-pass dwell time and total fixation duration. The first, first-pass dwell time, is a measure of the first pass from through a text from left to right. It is the sum of all of the fixations on a word when it is read on the first pass, before moving to another word. Total fixation duration is the sum of all fixations on a target word. Regressions and forward fixations are included in this measure (Rayner, 1998).

**Stimuli.** Two articles from the current media were used as primes for the information related to gender schemas. These articles came from a reputable news source and were as current

as possible. The first article commented on an initiative being undertaken which was related to women in the fields of science, technology, engineering, and mathematics. This served as the gendered prime for participants in the heightened condition of fluency. A second article which was unrelated to gender was used as the prime for participants in the lowered condition of fluency.

Target stimuli were adapted from Kreiner, Sturt, and Garrod (2007), and kept with the grammatical construction outlined by Duffy and Keir (2004). Contextual sentences were created which preceded target sentences, which themselves began with a stereotypically male or female role name as the subject of the sentence followed by a verb and then the reflexive pronoun ‘herself’ or ‘himself’. These reflexive pronouns were used since they specify the gender of the subject and are long enough to require direct fixation, which provided useful data when recording eye-movements (Duffy & Keir, 2004). Interest areas were created for both iterations of the role names in each passage in the contextual sentences and for the reflexive pronouns within the final sentence.

Stimuli were separated into two conditions of congruence: schema-congruent stimuli and schema-incongruent stimuli. Each condition contained 20 passages, structured as mentioned above. Half of the stimuli in each condition contained schematic information about males, whereas the other half pertained to schematic information about females. An example of stimuli from each condition can be found in Appendix A. The reflexive pronouns dictated the condition in which a passage found itself. For example, in the passage “It had been a very long day at work. Many people had been in and out of the office, and the secretary had lots of paperwork to do. The secretary treated himself to a large sundae after work.”, the pronoun ‘himself’ dictates that this passage belongs in the schema-incongruent condition. In the schema-congruent

condition, the same passage was presented with the reflexive pronoun ‘herself’, which ensured that these passages could be compared directly.

**Attribute Ratings.** The attributes of familiarity and likeability were measured on rating scales ranging from 1 to 10. These scales were presented following each block of stimuli. A rating nearing 1 represented *not at all* “x”, whereas a rating nearing 10 represented *very much* “x”. Participants were instructed to indicate their answers using a response keyboard, on which they used buttons 1-0 (representing 10) to give their ratings.

**Awareness.** At the end of the experiment, a question pertaining to participants’ awareness of the theme of gender was asked. As per Lewicki et al. (1987), participants were asked directly to list any themes they noticed throughout the experiment. These answers were recorded on a provided response sheet. This was a direct, subjective method of measuring awareness which allowed us to gather first-person data regarding the contents of participants’ awareness (Timmermanns & Cleeremans, 2015).

## **Procedure**

Participants were tested individually in an experimental session which was approximately 30 minutes in duration. After the completion of the Consent Form and Demographics Questionnaire, participants were instructed to read an article stemming from a popular news outlet which was either related or unrelated to the theme of gender. The participants were then subjected to the processing fluency manipulation of directed forgetting: they were instructed to forget what they had just read. The order of the prime was counterbalanced, so that half of the participants were in the heightened fluency condition and half were in the disfluent condition. All participants were then instructed to move on to the next part of the experiment, where they were led to a private

room and seated 60 cm from a display computer. A response keyboard was placed in front of them. They were instructed place their heads on a chin rest, and the researcher proceeded to calibrate the eye-tracking camera.

The experiment being used in this study was programmed using the Experiment Builder software which is compatible with the Eyelink 1000 eye-tracking system. It began with a fixation point shown in the middle of a black screen which remained on the screen for 300ms. The program then assigned participants into one of 2 groups in order to counterbalance the congruence conditions: the first group encountered the schema congruent stimuli first, followed by the schema incongruent stimuli, whereas the second group encountered the schema incongruent stimuli first followed by the schema congruent stimuli. All participants encountered all passages in each condition of schema congruence. Participants were given a break between blocks.

In the congruent block, passages which contained information matching gender schemas was shown. These included passages with information matching both male and female schemas. Contrarily, passages which contained information which went against female and male gender schemas made up the incongruent condition. These passages appeared as black text written in a 12-point Times New Roman font type displayed on a white background. There were 20 passages (trials) in each block, the order of which was randomized to eliminate any order effects between blocks. An even number of female- and male-related stimuli were shown in each condition. Eye movements were recorded for each passage, which allowed for a measure of reading speeds in each target area for every passage. For each participant, data from all three interest areas was aggregated to provide one overall measure of fixation duration for every passage. This same process was used when analyzing first-pass dwell time and total fixation duration. After each

passage, two 10-point rating scales pertaining to familiarity and to likeability were presented. Participants were instructed to answer using keys 1 through 0 (representing 10) on the keyboard in front of them. These scales were repeated after each trial. Finally, participants were asked directly about any themes they believe to have encountered. This short question was asked verbally at the end of the entire experiment, as per Lewicki (1987). Answers were written down by the researcher on a provided answer sheet. These answers were analysed for frequency and level of theme awareness.

## Results

### Eye Movements

**First-pass dwell time.** A mixed-design ANOVA with character gender (female, male) and schema congruence (congruent, incongruent) as within-subject factors and priming condition (gendered, neutral) as a between-subjects factor was conducted to examine the time spent on the reflexive pronouns in the first pass through the text. Results revealed a significant main effect of congruence, [ $F(1,76)=4.79, p=.03, \eta^2_p=.06$ ], but no significant main effect of gender, [ $F(1,76)=0.57, p=.45$ ]. The interaction between gender and priming condition was not significant, [ $F(1,76)=0.11, p=.75$ ]. There was a significant interaction between congruence and priming condition, [ $F(1,76)=9.80, p<.002, \eta^2_p=.11$ ], and a significant interaction between gender and congruence, [ $F(1,76)=8.203, p<.005, \eta^2_p=.10$ ]. The interaction between gender, congruence and priming condition was not significant, [ $F(1,76)=0.91, p=.34$ ].

Simple main effects tests were conducted to explore the interaction between congruence and priming condition. In the schema congruent condition, results revealed no significant main effect of priming conditions, [ $F(1,77)=1.53, p=.22$ ]. This suggests that there was no difference in

the time spent reading target words on the first pass within the schema congruent condition between participants who had received the gendered prime and those who had received the neutral prime. In the schema incongruent condition, results revealed no significant main effect of priming condition, [ $F(1,76)=2.38, p=.13$ ]. This suggests that within the incongruent condition, participants who had received the gendered prime spent an equal amount of time reading target words as did those who had received the neutral prime. In the gendered priming condition, results revealed a significant main effect of congruence, [ $F(1,38)=11.14, p<.002, \eta^2_p=.23$ ], which suggested that participants spent more time reading target words in the schema incongruent passages than in the schema congruent passages. In the neutral priming condition there were no significant differences in first-pass dwell times between conditions of congruence, [ $F(1,38)=0.61, p=.44$ ]. Thus, participants spent an equal amount of time reading target words within the schema congruent and schema incongruent conditions.

Simple main effect tests were also conducted to explore the interaction between gender and congruence. Results revealed no significant difference between conditions of congruence for female characters, [ $F(1,77)=0.26, p=.61$ ]. Thus, participants spent an even amount of time reading schema congruent and schema incongruent target words related to women on their first pass through the text. For male characters, results revealed a significant main effect of congruence, [ $F(1,77)=11.85, p<.001, \eta^2_p=.13$ ]. This result suggested that for male characters, schema incongruent target words were read more slowly than schema congruent target words on the first pass through the text. Furthermore, results revealed no significant difference between genders within the congruent condition, [ $F(1,77)=1.62, p=.21$ ], which suggests that participants read schema congruent target words related to men and women equally quickly. However, there was a significant main effect of gender in the incongruent condition, [ $F(1,77)=5.13, p<.026$ ,

$\eta^2_p=.062$ ], suggesting that participants read schema incongruent target words related to female characters faster than those related to male characters.

**Total fixation duration.** A mixed-design ANOVA with character gender (female, male) and schema congruence (congruent, incongruent) as within-subject factors and priming condition (gendered, neutral) as a between-subjects factor was conducted to examine the proportion of time spent on the reflexive pronouns. Means and standard deviations are presented in Appendix B, Table 4. Results revealed a significant main effect of gender, [ $F(1,76)=6.21, p<.015, \eta^2_p=.08$ ], as well as a significant main effect of congruence, [ $F(1,76)=13.65, p<.001, \eta^2_p=.15$ ], but no significant main effect of priming, [ $F(1,76)=0.005, p=.95$ ]. The interaction between gender and priming condition was not significant, [ $F(1,76)=3.50, p=.07$ ], nor was the interaction between congruence and priming condition, [ $F(1,76)=3.01, p=.09$ ]. There was no significant interaction between gender and congruence, [ $F(1,76)=0.17, p=.68$ ]. The interaction between gender, congruence, and priming condition was not found to be significant, [ $F(1,76)=0.85, p=.36$ ]. In sum, results revealed that participants spent more time reading phrases related to male characters than to female characters and that participants read congruent passages faster than incongruent passages.

### Attribute Ratings

**Familiarity.** A mixed-design ANOVA with character gender (female, male) and schema congruence (congruent, incongruent) as within-subject factors and priming condition (gendered, neutral) as a between-subjects factor was conducted to examine the effects of these variables on familiarity. Means and standard deviations are presented in Appendix B, Table 1. Results revealed no significant main effect of gender [ $F(1,76)=1.51, p=.22$ ], nor of congruence, [ $F(1,76)=0.33, p=0.57$ ], nor of priming condition, [ $F(1,76)=0.01, p=.92$ ]. Results revealed no

significant interaction between gender and priming condition, [ $F(1,76)=1.19, p=.28$ ], between congruence and priming condition, [ $F(1,76)=2.43, p=.12$ ], nor between gender and congruence, [ $F(1,76)=0.001, p=.97$ ]. Results also revealed no significant interaction between gender, congruence, and priming condition, [ $F(1,76)=0.001, p=.97$ ].

**Likeability.** A mixed-design ANOVA with gender (female, male) and schema congruence (congruent, incongruent) as within-subject factors and priming condition (gendered, neutral) as a between-subjects factor was conducted to examine the effects of these variables on likeability. Means and standard deviations are presented in Appendix B, Table 2. Results revealed no significant main effect of gender, [ $F(1,76)=0.69, p=.41$ ] nor of congruence, [ $F(1,76)=0.48, p=.49$ ], nor of priming condition, [ $F(1,76)=0.03, p=.86$ ]. A significant interaction between gender and priming condition was found, [ $F(1,76)=9.27, p<.003, \eta^2_p=.11$ ]. However, there was no significant interaction between congruence and priming condition, [ $F(1,76)=1.08, p=.30$ ]. The interaction between gender and congruence was found to be significant, [ $F(1,76)=15.42, p<.001, \eta^2_p=.17$ ]. Results revealed a significant three-way interaction between gender, congruence, and priming condition, [ $F(1,76)=4.93, p<.03, \eta^2_p=.06$ ].

Due to the three-way interaction, a 2x2 repeated-measures ANOVA was computed for each priming condition to compare likeability responses in terms of gender (female vs. male) and congruence (congruent vs. incongruent). In the gendered priming condition, the analysis revealed no significant main effect of gender, [ $F(1,38)=1.97, p=.17$ ], and no significant main effect of congruence, [ $F(1,38)=1.34, p=.25$ ]. Results revealed a significant interaction between gender and congruence, [ $F(1,38)=17.15, p<.001, \eta^2_p=.31$ ].

Simple main effects tests were computed to explore the interaction. For these following analyses, Dunn's correction was applied. Thus, to be considered significant  $p$  had to be smaller



than .038. In the congruent condition, there was no significant difference in likeability ratings between character genders, [ $F(1,38)=4.23, p=.05$ ]. In the incongruent condition, participants rated female characters as being less likeable than male characters, [ $F(1,38)=15.46, p<.001, \eta^2_p=.29$ ]. In comparing congruence conditions, it was found that incongruent female characters were rated as being less likeable than congruent female characters [ $F(1,38)=16.26, p<.001, \eta^2_p=.30$ ]. However, likeability did not differ between males in the congruent condition and in the incongruent condition, [ $F(1,38)=4.08, p=.05$ ].

For the neutral priming condition, results revealed a significant main effect of gender, [ $F(1,38)=9.95, p<.003, \eta^2_p=.21$ ], but no significant main effect of congruence, [ $F(1,38)=0.07, p=.79$ ]. There was no significant interaction between gender and congruence, [ $F(1,38)=1.62, p=.21$ ]. For the main effect of gender, results revealed that male characters in this priming condition were rated as being less likeable than female characters.

### **Explicit Awareness**

Participants were asked to provide a response indicating their explicit awareness of any theme throughout the study. Responses can be found in Appendix B, Table 5. Analyses of likeability, familiarity, first-pass dwell time, and total fixation duration were run with the addition of explicit awareness as an independent variable. Explicit awareness was coded dichotomously, where 0 represented no awareness of the gender theme, and 1 represented gender theme awareness. Separate analyses were conducted in which explicit awareness was encoded in three groups, where 0 represented no awareness of any theme, 1 represented gender theme awareness, and 2 represented the awareness of a theme other than gender. None of the analyses including explicit awareness demonstrated significant effects of this IV or significant interactions

with the IVs of gender, schema congruence, or priming condition on any of the DVs. Therefore, for the sake of brevity, explicit awareness results will not be reported herein.

## **Discussion**

The current study examined the effects of priming conditions on schema violations and attribute ratings while recording eye-movements. Participants received a prime which was thematically related or unrelated to information they would later encounter in a reading task which included both schema-congruent and schema-incongruent passages. Measures of participants' eye movements allowed for an inference of their reading speeds, and were used to determine if this changed as a function of schema congruence or in relation to the prime they had received. This study also sought to lend support to the hedonic marking hypothesis (Laham et al., 2009; Winkielman, Schwarz, Fazendeiro, and Reber, 2003; Winkielman et al., 2007), according to which ease of processing leads to a more positive affect, which results in the increased likeability of the stimulus itself. To explore this, participants were asked to rate the familiarity and the likeability of the characters in each passage. Finally, this study aimed to explore the need for the explicit awareness of a theme in relation to its effect on cognitive processing. Participants were asked to identify any themes they thought they had encountered throughout the study, and the results of this analysis is discussed below.

## **Eye Movements**

**First-pass dwell times.** This study measured eye-movements to determine reading speed differences between conditions of congruence and conceptual fluency. Reading speed differences on the first encounter of the target words from left to right within each passage were measured, and results revealed two significant interactions related to this measure. First, results revealed an

interaction between conditions of congruence and priming condition. Participants who had received the gendered prime dwelled longer on target words in schema incongruent passages than in schema congruent passages on their first pass through the text. In other words, if they had previously encountered the gendered prime, participants processed schema incongruent information with more difficulty than schema congruent information on their first encounter with it. This result had been hypothesized, since previous studies have demonstrated that primes which are related to schematic information and which precede schematic information tend to heighten the fluency of this information and lower the fluency of incongruent information (Bjork & Bjork, 2003; Dickinson, 2011; Duffy & Keir, 2004). Simply put, the gendered prime in this study made further information which was congruent with the schema relatively easier to process, while simultaneously making information which was opposite the gender-occupation schema more difficult to process. Interestingly, the gendered prime used within this study consisted of counter-stereotypical information related to women (CBC, 2018). Thus, the content of this priming condition was schema incongruent, and it could have been suggested that this may have primed further schema incongruent information. However, since participants were not deliberately instructed to pay attention to the nature of the prime, the schema incongruent prime may have served to prime the schema itself instead of further incongruent information. To elaborate, it has previously been demonstrated that counter-stereotypical information can serve as a prime for further counter-stereotypical information only when the perceiver has the intention to reverse the effects of a stereotype and the cognitive constraints of the task are low, e.g. the task is not complex or there is ample time given to complete it (Blair & Banaji, 1996). In addition, Fiske and Neuberg (1990) found that outcome dependency and perceiver intention could overcome stereotypic biases on explicit judgments but could not overcome such biases

when expressing non-verbal judgments. In other words, participants were able to make more unprejudiced explicit judgments when they intended to, but their non-verbal cues still demonstrated implicit bias (Fiske & Neuberg, 1990). Within the current study, participants were not informed of the nature of the task to come, so their intention to process counter-stereotypical information was not heightened. In other words, participants did not knowingly intend to reverse the effects of the gender-occupation stereotype. In addition, eye-tracking data can be used as an implicit measure of bias, thus it could should remain unaltered by the exposure to a counter-stereotypical prime even if the participants intended to counteract stereotype effect. In sum, the interaction between priming and schema congruence within this study are not unexpected. The incongruent gendered prime likely heightened the fluency of the schema itself, thus resulting in later schema congruent information being processed more quickly than schema incongruent information.

Furthermore, first-pass data also revealed a significant interaction between character gender and schema congruence. Within this interaction, schema incongruent passages related to males were read more slowly than schema congruent passages related to this same gender, though there was no difference in reading speeds between congruent and incongruent passages for females. In addition, incongruent passages related to males were read more slowly than their incongruent female counterparts. These results had also been hypothesized, since schemas related to male characters are seemingly more concrete and more entrenched in our thinking than those related to female characters (Dickinson, 2011; Koenig, 2018). Previous studies have found that for both schemas of sexuality and of gender, schema incongruent information related to male characters can lead to increased processing slowdowns when compared with their schema incongruent female counterparts (Dickinson, 2011; Kennison & Trofe, 2003; Koenig, 2018;

Steffens, 2005). Therefore, the slowdown in reading speeds on the first pass through the texts within the current study in which stereotypically female careers were followed by a male reflexive pronoun was expected, as it follows the results of the existing literature. Furthermore, this result contributes to the conclusions drawn within such literature, which state that stereotypes related to males are more inflexible than those related to women, and that their violation impacts processing to a greater degree than the violation of stereotypes about women.

**Total fixation duration on pronouns.** To infer reading speeds, the time spent reading the reflexive gender pronouns which occurred in the final sentence of every passage and which were related to the subject of the text, which was an occupational role name, were measured. Results revealed differences in the time spent in these target areas between the conditions of congruence, with participants spending more time reading target words in schema-incongruent passages in comparison to their schema-congruent counterparts. That is, participants spent more time reading counter-stereotypical information than stereotypical information. This result had been hypothesized, since studies regarding schema violations have previously found longer latencies in processing speeds when schema-incongruent information is encountered (Dickinson, 2011; Duffy & Keir, 2004). Thus, this result lends itself to the idea of the mismatch effect, according to which stimuli which are not in accordance with previously activated schematic expectations are processed more slowly than stimuli which do match such expectations (Banaji & Hardin, 1996; Dickinson, 2011; Duffy & Keir, 2004; Siyanova-Chanturia, Warren, Pesciarelli, & Cacciari, 2015). As such, when pronouns that did not match the gender-occupation stereotypes which had previously been activated within the text were encountered readers spent more time dwelling on these pronouns, so overall reading speed tended to slow. In contrast, when pronouns which matched the activated gender-occupation stereotype were encountered, total fixation times

were shorter and reading speed was faster. In other words, it was easier for participants to process stereotypical information than it was for them to process counter-stereotypical information about various occupations, which suggests that beliefs about men and women in different jobs are socially ingrained and inflexible, and that these beliefs affect our ability to process information (Duffy & Keir, 2004; Koenig, 2018). This finding was hypothesized, since previous literature has suggested that occupations are often perceived as being sex-segregated, and that this type of stereotyping affects our cognitive interpretations of the information we encounter, such as the speed with which we read or categorize information (Chaxel, 2015; Duffy & Keir, 2004; Miller & Hayward, 2006). Furthermore, the segregation of occupational roles based on gender has been linked to job selection, satisfaction, as well as interviewer ratings and hiring decisions (Miller & Hayward, 2006; Janssen & Backes-Gellner, 2016). Most notably, gender-occupation stereotypes are also reflected in demographic data, with men typically selecting stereotypically-male jobs, and women typically selecting “female” jobs (Janssen & Backes-Gellner, 2016). Thus, it is possible that this stereotyped occurrence contributes to the entrenchment of male and female occupational stereotypes. Altogether, the deep entrenchment of such stereotypes makes processing stereotypical information easier and counter-stereotypical information harder, thus leading to the differences in reading speeds which were observed in this study.

Reading speeds of the reflexive pronouns also differed between character genders, with participants spending more time reading passages related to male characters than passages containing female characters. However, no relationship between the impact of schema congruence and character gender was found. This means that texts related to male characters were processed more slowly than those related to female characters regardless of whether they

matched or violated a gender-occupation schema. This finding contrasts those of the first-pass dwell times, in which there was a significant interaction between gender and conditions of congruence. Within total fixation duration, slowed processing related to males was hypothesized for the incongruent condition, but it was unexpected in the congruent condition. To elaborate, one hypothesis of this study was that schema violations related to male characters would be processed more slowly than schema violations related to female characters; that is, it was expected that passages which contained counter-stereotypical occupational roles for males would be read more slowly than those related to females (Siyanova-Chanturia, Pesciarelli, & Cacciari, 2012). The results in the incongruent condition of this study are in line with those of Reali, Esaulova, and von Stockhausen (2014) who found that participants fixated on male pronouns longer than female pronouns in anaphoric sentences. Thus, the results of the current study support the aforementioned hypothesis, and suggest that stereotypes related to males are more heavily entrenched and remain more inflexible than those related to women (Dickinson, 2011; Koenig, 2018; Reali et al., 2014). However, passages in the schema congruent condition which were related to males were also read more slowly than their female counterparts. This was an unexpected result since male occupational stereotypes seem to be more heavily entrenched in our cognitions, so it would follow that congruent male passages should have been processed more quickly than female passages. That said, it is likely that the large number of female participants within this study contributed to the latencies produced when reading passages pertaining to male characters, since the data suggests that female participants' reading speeds differed between character genders. This would be in-line with the findings of Banaji and Hardin (1996), who noted that participants responded significantly more quickly to target words which matched their own genders than to those of opposite genders. In addition, studies using Event-Related

Potentials have suggested that female participants process gender stereotype information differently than their male counterparts (Osterhout, Bersick, & McLaughlin, 1997; Siyanova-Chanturia et al., 2012). This may be due to female participants' grammatical awareness and sensitivity to grammatical violations (Siyanova-Chanturia et al., 2012). Thus, it would follow that the number of female participants within the current study may be responsible for the longer latencies in passages pertaining to male characters within both conditions of congruence.

Furthermore, based on the findings of MacCrae et al. (1997) and Araya et al. (2003), it was hypothesized that under the instruction to forget the previously encountered prime, thematically-related information would be processed more easily – and therefore more quickly – than thematically-unrelated information. In other words, it was hypothesized that since directed forgetting can heighten the accessibility of a prime and impact cognitive processing, participants who received the gendered prime would process related, schema congruent information more quickly than schema incongruent information. Despite this, differences in processing were seemingly unrelated to priming conditions, meaning that the gendered prime and the neutral prime did not significantly impact the speed with which the passages in various gender and congruence conditions were read. This result might be explained by the nature of the task being used within this study, since the reading task which was employed in this study was not a direct test of memory processes. Although other indirect tests of memory such as speeded word reading tasks have found that the directed forgetting of a prime can influence reading latencies, the primes used in this task were thematic news articles and later stimuli were composed of multiple three-sentence passages (MacLeod & Daniels, 2000). Thus, the stimuli used within this study were much longer than those in the existing literature and this could have negated the cognitive effects of directed forgetting. Furthermore, although certain authors suggest that directed



forgetting can impact indirect tests of memory to a similar extent as direct tests of memory, this remains a point of contention within the literature. In following, it has been suggested that directed forgetting demonstrates larger processing differences in direct tests of memory since these are more sensitive to encoding processing, and since they require the intentional retrieval of items (Hogge, Adam, & Collette, 2008). In sum, the use of directed forgetting as a form of implicit priming in conjunction with an indirect test of memory such as a reading task did not affect participants' reading latencies within this study.

### **Attribute Ratings**

**Likeability.** Attribute ratings were gathered by presenting participants with two, 10-point rating scales on which they were asked to rate each passage's likeability and familiarity. Participants gave ratings ranging from 1, *not at all "x"*, to 10, *very much "x"*. Results revealed that ratings of likeability were significantly impacted by the priming condition, the character gender in each passage, and the passage's schema congruence. Most notably, those who received the gendered prime rated schema incongruent passages relating to female characters as being less likeable than their female schema congruent fellows. In addition, these passages were also said to be less likeable than their male equivalents in both the incongruent and congruent conditions. To illustrate, the passage pertaining to a female farmer would have been generally rated as being less likeable than the passage about a female nurse. It would also have been rated as being less likeable than the passages pertaining to male nurses and male farmers. These results are of interest since they contradict the hypothesis that passages pertaining to male characters would be rated as being less likeable due to the inflexibility of male stereotypes and the effects of their violation (Koenig, 2018). Moreover, females in incongruent positions may have been rated as being less likeable due to participants' preference of encountering female characters in typically

female jobs. For example, Teig and Susskind (2008) found that young and older girls preferred female characters to be in gender appropriate professions, regardless of job status. A similar finding by Frankowski (2017) suggested that female participants made more gender congruent career path decisions than incongruent ones. That is, more females chose typically female jobs than typically male jobs. It would follow that females in incongruent positions would be rated as less likeable in the current study, since there is a tendency to prefer women in stereotypically female roles, and that this preference exists throughout the lifetime. In summary, this finding speaks to efforts to change stereotypical views since it suggests that the portrayal of female character within a counter-stereotypical role may not be as well received as the portrayal of a man in a similar position.

The results of the current study also revealed that participants who received a neutral, unrelated prime rated passages related to male characters as being less likeable than their female counterparts, regardless of schema congruence. To illustrate, passages related to a male in a typically male role, such as a male lawyer, as well as passages alluding to a male in a typically female role, such as a male dancer, received lower ratings of likeability than their female equivalents (a female lawyer and a female dancer), regardless of congruence. This result is in line with the results of Koenig (2018), who found that stereotypes related to men tend to be more inflexible across their lifetime than those related to women. In their study, Koenig (2018) utilized prescriptive stereotypes in the form of character traits, and had participants rate the desirability of weak men vs. dominant women across various age groups. The results of their study suggested that the violation of stereotypes related to elementary-aged boys, adolescents, adult males, and elderly males was less desirable than the violation of stereotypes related to females across the same age groups. Briefly, these findings suggest that even when compared directly,

stereotypes related to males were more inflexible than those related to women (Koenig, 2018). Under the neutral priming condition, the results of the current study support the findings of Koenig (2018), since they suggest that male stereotypes and their violations are less likeable than their female counterparts, which may be due to their deep entrenchment and inflexibility within our culture.

In comparison with the results of the gendered priming condition, the results of the neutral priming condition add some perspective to the ways in which primes might affect our metacognitive judgments. For instance, participants' judgments of character likeability differed whether they had received a prime which was thematically-related to the content of the passages they would view later or a prime which was neutral, and thematically-unrelated to such passages. Thus, the differences between the results of each priming condition suggest that the information which is encountered before we process target information effects how the later information is processed and interpreted. In the gendered prime condition, ratings of likeability changed between genders and between conditions of schema congruence, which suggests that the way in which a counter-stereotypical prime is presented can influence later judgments of stereotypical and counter-stereotypical information related to men and women (Bligh et al., 2011). In the neutral prime condition, ratings of likeability were solely affected by character gender, with males receiving lower ratings of likeability than females. This suggests that when counter-stereotypical information is not cognitively primed, stereotypes related to males remain more inflexible and more deeply entrenched than those related to women (Koenig, 2018). In summary, the prime which one receives before encountering stereotypical and counter-stereotypical information can influence the metacognitive processing of such information.

**Familiarity.** Ratings of familiarity were gathered in the same way as those of likeability; participants responded to a 10-point rating scale after having read each passage which asked them to rate the familiarity of the character they had just encountered. Results surrounding these ratings of familiarity found no significant differences between priming conditions, genders, or schema congruence, nor any interaction between these IVs.

Interestingly, this finding lends insight into the mechanisms of processing fluency and its effect on various attribute ratings. The finding that familiarity remained unaffected by changes in conceptual fluency refutes the idea that ratings of likeability may be indirectly affected by fluency through the mediator of familiarity (Lanska et al., 2015). In their study, Lanska et al. (2015) found that familiarity was the attribute rating which was most heavily affected by processing fluency, and they related this finding to the *attributional account* of fluency. According to this account, since fluency is related to prior experience, stimuli which have previously been encountered are processed more rapidly and easily than novel items (Lanska & Westerman, 2018). Thus, the expectations formed by the participant based on their past experiences and current context affect their perceptions of the familiarity of an item, in turn affecting the perceived likeability of the same stimulus (Lanska et al., 2015; Lanska & Westerman, 2018; Whittlesea, 1993). However, since the perceived familiarity of the stimuli in the current study did not differ according to conditions of fluency, this finding opposes the attributional account of fluency. Rather, this finding lends support to an alternative explanation of fluency, called the *hedonic marking hypothesis* (Winkielman et al., 2003). As mentioned above, the hedonic marking hypothesis states that the positive affective experience stemming from the ease of processing a piece of ‘fluent’ information leads participants to rate fluent stimuli more positively than disfluent stimuli. Thus, the stimulus receives more positive affective

ratings, such as a higher rating of likeability (Laham et al., 2009; Winkielman, Schwarz, Fazendeiro, and Reber, 2003; Winkielman et al., 2007). The results of the current study lend support to this hypothesis since likeability seemingly increased across conditions of fluency, i.e. the priming conditions, but ratings of familiarity did not. To illustrate, the gendered priming condition was meant to increase the conceptual fluency of the passages which were to follow since the article which served as a prime was thematically related to the following stimuli. Under this condition, likeability ratings differed according to character gender and schema congruence. A similar result was not found in the neutral priming condition (i.e. the lower fluency condition), thus suggesting that heightened conceptual fluency had a significant effect on the attribute rating of likeability. However, the perceived familiarity of each stimulus remained unaffected by the priming condition (i.e. fluency condition), the character gender, or the schema congruence of the passage. Thus, the results of the current study lend further support to the explanation of the workings of fluency as stated by the hedonic marking hypothesis.

### **Explicit Awareness**

Explicit awareness was measured by having participants describe any themes they may have noticed throughout the study at the end of their experimental session. Participants' responses were coded dichotomously and in groups of three as described above. Responses were included as an independent variable in analyses for first-pass dwell times, total fixation duration, familiarity ratings, and likeability ratings. Results revealed no impact of explicit awareness on any of these dependent variables. This suggests that the explicit awareness of the theme of the study did not contribute to the effects of processing fluency on cognitive or metacognitive processing. In other words, fluency, which was increased in the gendered prime condition and lower in the neutral prime condition, can operate independently of explicit awareness while still

having an impact on our reading speeds and attribute ratings. This finding aligns itself with the suggestion by Lewicki et al. (1987) that the awareness of an ease of processing manipulation is not required for the manipulation to impact processing. Furthermore, it contradicts Oppenheimer's (2008) suggestion that fluency can only impact processing if an individual is aware of the heightened or lowered ease of processing they are experiencing.

Nonetheless, it is possible that the type of fluency which was manipulated in this study accounts for the lack of a need for awareness in fluency's effects on cognitive and metacognitive processing. Previous research has largely studied the effects of perceptual fluency on various cognitive processes (e.g. reading, recognition, and memory tasks), or of perceptual fluency in conjunction with conceptual fluency (Alter & Oppenheimer, 2009). However, this study solely employed a manipulation of conceptual fluency by priming participants with articles which were either related or unrelated to the passages which were to follow. As a result, explicit awareness was not necessary for fluency to affect processing within this study.

### **Limitations and Future Directions**

One potential limitation to the current study is the discrepancy between the number of female and male participants. As has been suggested throughout the text, participants of differing genders may process stereotypical information differently, and participants may be more likely to identify with and process information related to their own gender identity more easily than information related to an out-group (Banaji & Hardin, 1996; Teig & Susskind, 2008). Thus, future studies should seek to obtain data from an even number of male and female participants, or solely from participants of one gender to examine differences between these groups. Furthermore, the nature of the gendered prime may have influenced participants' ratings of the passage characters' likeability and familiarity, since it pertained to a female in a counter-

stereotypical role (Bligh, Schlehofer, Casad, & Gaffney, 2011). With that said, future studies may aim to explore the differences in the cognitive and metacognitive processing of schematic information when primes related to various genders and occupations are encountered (e.g. differences between male, female, transgender, and gender non-binary participants who encounter stereotypical or counter-stereotypical primes).

## **Conclusion**

The current study aimed to determine the impacts of processing fluency in conjunction with schema congruence on cognitive and metacognitive processes. Overall, results suggested that schema congruence accounted for greater differences in reading speeds than fluency did. For first-pass dwell time, an interaction between schema congruence and priming condition was found. This result demonstrated that individuals who received the gendered prime spent more time reading schema incongruent pronouns than schema congruent pronouns. Additionally, an interaction between congruence and gender was found for this measure, in which incongruent male pronouns were read more slowly than their congruent counterparts, and in which male incongruent pronouns were read more slowly than female incongruent pronouns. As for total fixation duration, a main effect of gender was found which revealed that male pronouns were read more slowly than female pronouns. Effect sizes of these interactions and main effects ranged from  $\eta^2_p=.06$  to  $\eta^2_p=.31$ . Moreover, an interaction occurring between processing fluency, schema congruence, and character gender lead to differences in ratings of character likeability. These results demonstrated that for the neutral priming condition, the incongruent female characters were rated as being less likeable than their male equivalents. Additionally, incongruent females were rated as being less likeable than congruent females. In the neutral condition, males were rated as being less likeable than females. Furthermore, the results of the

current study suggest that attribute ratings are impacted by the positive affect stemming from easier processing rather than by the feelings of familiarity which they might elicit, thus lending support to the hedonic marking hypothesis. This can be affirmed since significant results were obtained for the ratings of likeability, although no significant differences were found for ratings of familiarity. Finally, the results of this study suggest that the explicit awareness of an overall theme is unrelated to both cognitive and metacognitive processes. In other words, processing fluency and schema congruence can operate without participants' awareness of any manipulation of the concept at play. In summary, these results provide insights into the effects of processing fluency and schema congruence on the interpretation of gender-occupational stereotypes. In conclusion, the results suggest that gender-occupation stereotypes remain deeply entrenched in our cognitions, and that new strategies must be sought to present counter-stereotypical information so that it is received as intended.



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## Appendix A

## Congruent-male:

After yesterday's storm, there were broken tree branches all over the yard. A neighbor asked the farmer for some help with cleaning it all up. The farmer agreed to do the work, thinking to himself that it was a nice gesture.

## Congruent-female:

The hospital had gotten negative comments about the wait in the emergency room. Patients were angry about sitting around for hours, which the nurse understood. The nurse reminded herself to be empathetic upon seeing the patients.

## Incongruent-male:

The hospital had gotten negative comments about the wait in the emergency room. Patients were angry about sitting around for hours, which the nurse understood. The nurse reminded himself to be empathetic upon seeing the patients.

## Incongruent-female:

After yesterday's storm, there were broken tree branches all over the yard. A neighbor asked the farmer for some help with cleaning it all up. The farmer agreed to do the work, thinking to herself that it was a nice gesture.

## Appendix B

Table 1. Mean familiarity ratings by character gender, congruence condition, and priming condition.

Character Gender	Congruence Condition	Priming Condition	M	SD
Female	Congruent	Gendered	5.24	1.82
Female	Congruent	Neutral	5.07	1.58
Female	Incongruent	Gendered	4.95	1.67
Female	Incongruent	Neutral	5.21	1.70
Male	Congruent	Gendered	5.23	2.06
Male	Congruent	Neutral	4.90	1.81
Male	Incongruent	Gendered	4.94	1.31
Male	Incongruent	Neutral	5.03	1.67

Table 2. Mean likeability ratings by character gender, congruence condition, and priming condition.

Character Gender	Congruence Condition	Priming Condition	M	SD
Female	Congruent	Gendered	5.86	1.21
Female	Congruent	Neutral	5.77	1.12
Female	Incongruent	Gendered	5.17	1.39
Female	Incongruent	Neutral	5.65	1.39
Male	Congruent	Gendered	5.50	1.28
Male	Congruent	Neutral	5.32	1.43
Male	Incongruent	Gendered	5.89	1.22
Male	Incongruent	Neutral	5.50	1.40

Table 3. Mean first-pass dwell time by character gender, congruence condition, and priming condition.

Character Gender	Congruence Condition	Priming Condition	M	SD
Female	Congruent	Gendered	162.41	86.91
Female	Congruent	Neutral	185.81	79.96
Female	Incongruent	Gendered	194.05	73.88
Female	Incongruent	Neutral	163.80	73.24
Male	Congruent	Gendered	157.00	65.38
Male	Congruent	Neutral	176.08	68.12
Male	Incongruent	Gendered	203.69	90.64
Male	Incongruent	Neutral	184.21	68.35

Table 4. Mean total fixation time in the target area (reflexive pronouns) by character gender, congruence condition, and priming condition.

Character Gender	Congruence Condition	Priming Condition	M	SD
Female	Congruent	Gendered	233.71	130.82
Female	Congruent	Neutral	271.74	142.65
Female	Incongruent	Gendered	319.24	137.89
Female	Incongruent	Neutral	313.83	289.06
Male	Congruent	Gendered	261.75	131.54
Male	Congruent	Neutral	283.67	137.63
Male	Incongruent	Gendered	377.41	191.98
Male	Incongruent	Neutral	314.17	177.14

Table 5. Frequency of theme awareness responses by category.

Theme	Frequency of response
Gender	27
Occupations	4
Interpersonal interactions	18
Situations/experiences	9
Other	10
No response	12